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Vedr. patentansøgning

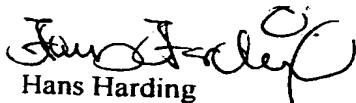
Hermed fremsendes en patentansøgning vedr. en metode til at reducere signal cross talk i elektriske kredsløb.

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Kvittering for modtagelsen bedes mærket "cross talk".

Med venlig hilsen

  
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**A method for reducing**  
**signal cross talk in electrical circuits**

# **A method for reducing signal cross talk in electrical circuits**

Aalborg University, November 28th 1999  
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## **Introduction**

Cross talk is a phenomenon occurring in all sorts of electronic equipment. It means that a signal that is intentionally present in one conductor is, at the same time, unintentionally present in one or more other conductors, although usually significantly damped. In many applications this is a problem; in some cases even a severe problem. We therefore propose a method for reducing this cross talk. The methods probably will have to rely on the possibility for digital signal processing before and after the cross talk occurs.

Key words: Cross talk, wavelet, circuit, sampled signal.

## **Description of the idea**

In a conductor, typically a wire on a printed circuit board, in a semiconductor component or in any component with inductance, a signal is transmitted. The other components in the device will all receive more or less of that signal. If there is a large amplification somewhere in the device this point is particularly sensitive. Unfortunately the cross talk is in some cases not immediately visible, for instance if the signals in the two wires differ only in amplitude. The cross talk then simply increases the signal. In an application where the amplitude of the signal is vital this is a major problem.

In our particular application the signals in the two wires are sampled signals, i.e. they are piece-wise constant in time, and they are supposed to be proportional. One signal is emitted as infra red (IR) light, while the other signal (in the other wire) is the intensity of light received with an infra red photodiode. Since the received light is very weak it is amplified significantly. All the solderings and wires from the receiver to the amplifier is hence sensitive to cross talk. Since the signals are not only sampled but also constructed and post-transmission processed by a wavelet transform, we propose to use the properties of this transform to determine the occurrence of cross talk.

By inserting a delay of a number of samples right before the transmitting diode the signal in the emitter circuit and the signal in the receiver circuit are time shifted this number of samples. Certain signals demonstrates very nice behaviours when shifted in the wavelet domain, and by transmitting such signals it is possible to separate the shifted (desired) and non-shifted (undesired) signals, and hence determine the contribution resulting from cross talk. Such a signal can be transmitted with frequent intervals to keep track of the cross talk, or continuously if the cross talk is expected to vary rapidly. The cross talk detection signal and the IR signal can also be transmitted simultaneously. This is possible due to the properties of the wavelet transform. Finally, the IR detection signal itself can be used for determining the effect of cross talk. This restrains the range of usable signals, however.

## Hierarchy of proposals

We propose:

1. Inserting a time delay between the occurrence of the signal in the first set of conductors and the other set of conductors, and designing the signals such that the effects of cross talk, which inherently will occur as time shifted version of the respective signals, are reduced or eliminated.
2. Inserting a time delay between the occurrence of the signal in the first set of conductors and the other set of conductors. After the occurrence of cross talk, a mathematical approach using delay time and the shape of the signals in question as parameters is applied to reduce or eliminate the cross talk.
3. A method combining proposal 1 and 2.
4. A method as in proposal 1, 2, or 3 where the signals in question are piece-wise constant in time, i.e., they are sampled signals.
5. A method as in proposal 4 where the delay time is an integer multiple of the sampling time.
6. A method as in proposal 5 where the design/mathematical approach involves wavelet transformations of the signals.
7. A method as in proposal 6 where the signals are designed specifically to match the wavelet transformations.
8. A method as in proposal 7 where the signal occurring in the first set of conductors are designed such that its presence in the other set of conductors can be partly or entirely determined.
9. A method as in proposal 6 where an extra signal is added to the existing signal to improve the reduction of cross talk.

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